

Optical properties of measurement cell material (BC-800)

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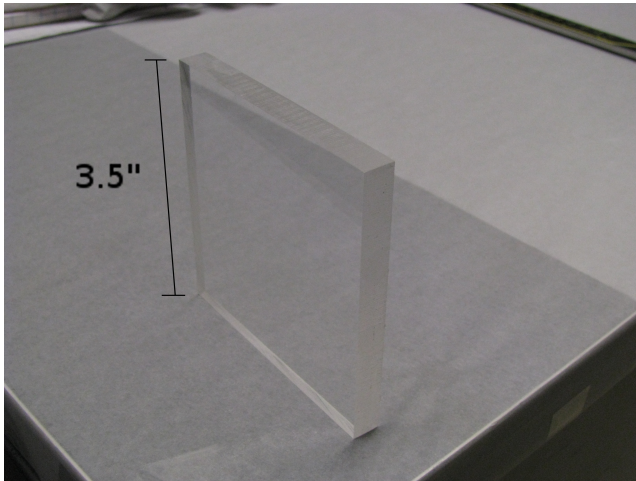
Department of Physics
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nEDM Collaboration Meeting
May 21, 2008



The sample

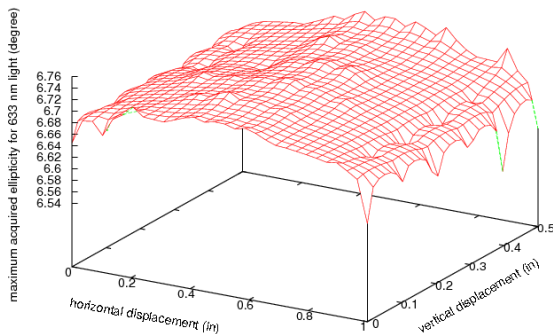
A sample of BC-800 (UVT PMMA) from Saint-Gobain:



Overall characteristic of sample

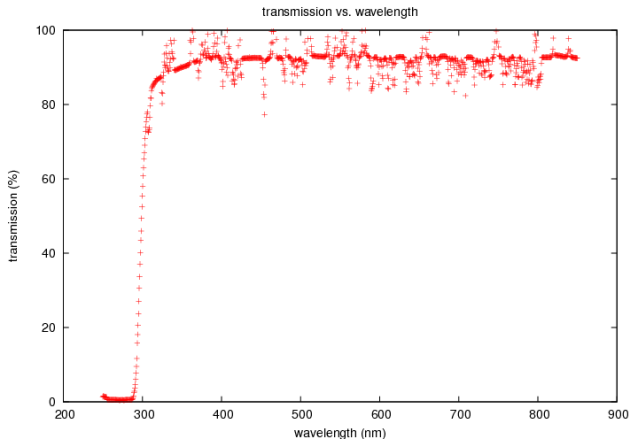
- Physical dimensions: $3.5'' \times 3.5'' \times 0.375''$
- Birefringence uniformity: uniform to a few percent over $1'' \times 0.5''$ area in the center

birefringence induced by internal stress over $1'' \times 0.5''$ area

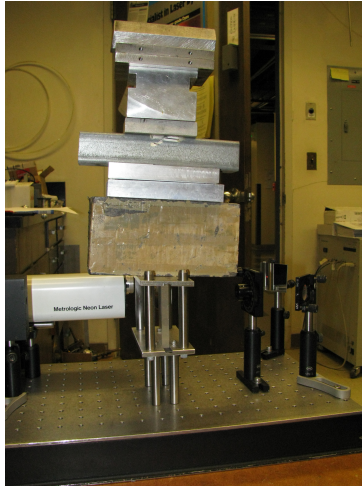


Transmission at 250 nm – 850 nm

- Result agrees with BC-800 spec and, at visible region, what is expected from the $n = 1.49$
- ... the fluctuation is probably spectrometer noise

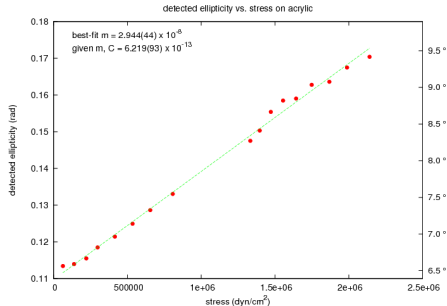


Photoelastic coefficient measurement



Photoelastic coefficient measurement

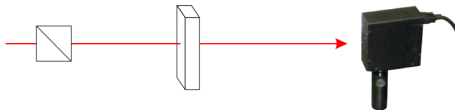
- Photoelastic coefficient¹, $C = 6.2 \times 10^{-13} \text{ cm}^2/\text{dyn}$, agrees with values found in literature for PMMA



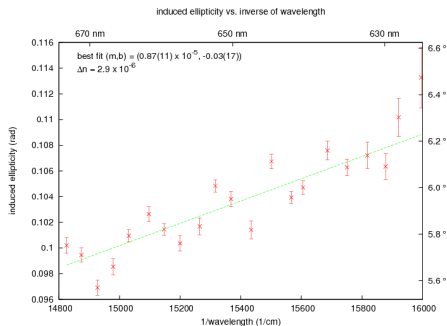
¹... defined as $\Delta n = C\sigma$, where σ is stress and Δn is change in birefringence due to stress



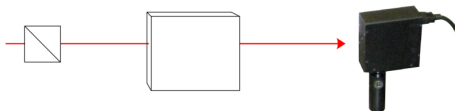
“Intrinsic” birefringence



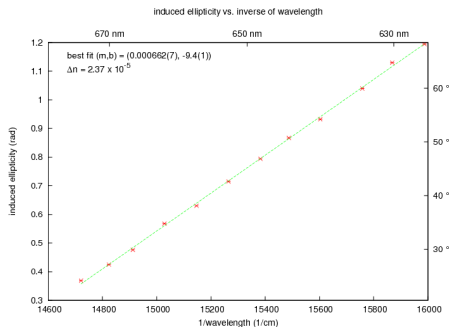
- Along the short dimension, ellipticity of about 6° is induced, corresponding to $\Delta n = 2.9 \times 10^{-6}$



“Intrinsic” birefringence

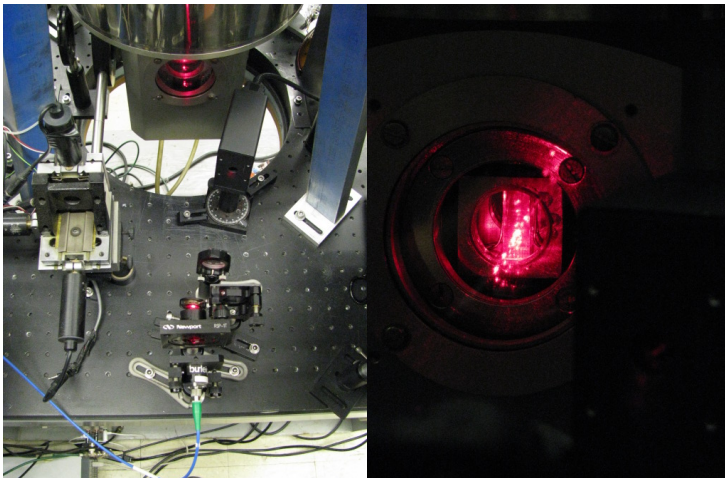


- Probing along the long dimension, birefringence larger by an order of magnitude is detected ($\Delta n = 2.4 \times 10^{-5}$)



“Intrinsic” birefringence, at low temperature

- Measurements done at temperatures down to 1.5 K
- Data is currently being analyzed, by modeling the effect of large ($> 20^\circ$ in induced ellipticity) window birefringence



Annealing

- The sample of BC-800 is annealed by putting it in an oven preheated to 120° (softening point², 96° , melting point³ $> 140^{\circ}$), baking for 4 hours, and cooling it slowly over 12 hours
- Overall birefringence is reduced,

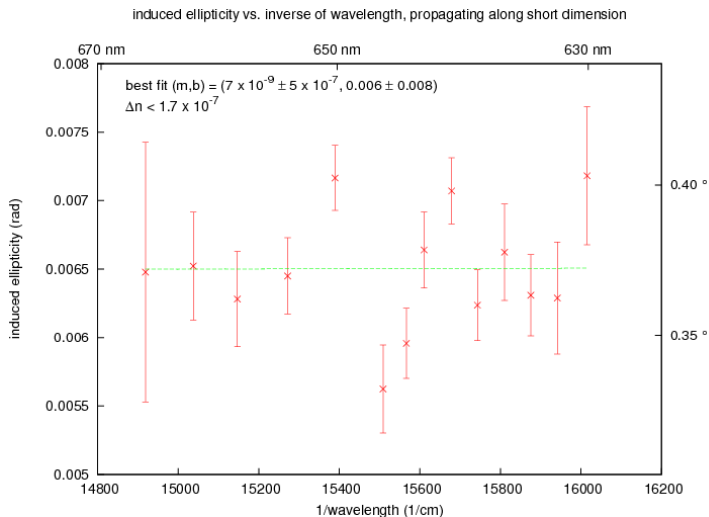
²according to BC-800 spec

³according to <http://en.wikipedia.org/wiki/PMMA>



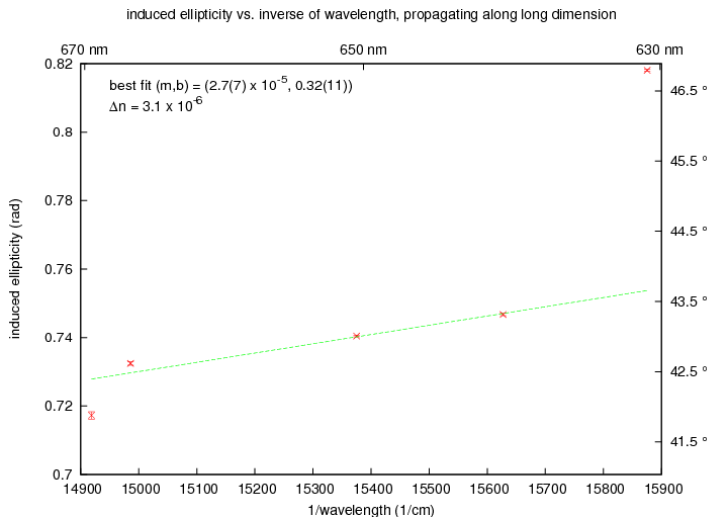
Annealing

along the short dimension ($\Delta n < 1.7 \times 10^{-7}$) ...



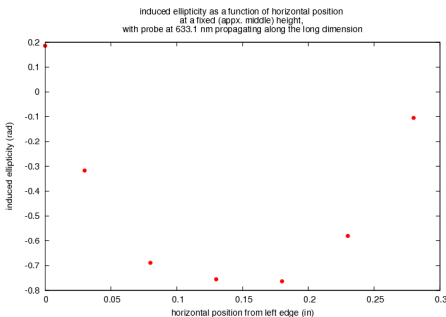
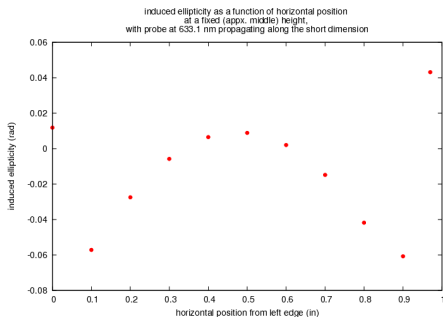
Annealing

... and along the long dimension ($\Delta n = 3.1 \times 10^{-6}$)



Annealing: uniformity

- But the uniformity is significantly affected, both along the short and long dimensions
- And the physical dimensions change significantly:
 - thickness: $0.375'' \rightarrow 0.387''$
 - height: $1.08'' \rightarrow 1.06''$



- Tests at cryogenic temperatures (down to 1.5 K in our cryostat), with and without annealing
- Annealing with different parameters
- Measurement of Kerr constant of BC-800 at LN_2 and LHe temperatures
- Kerr HV monitor implementation design based on parameters measured



To-Do

